Leveraging High Speed Modular Digitizers for PDV

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Acknowledgement
Cenobio Gallegos (NSTec – LAO)
Matthew G. Teel (NSTec – LAO)

NATIONAL INSTRUMENTS

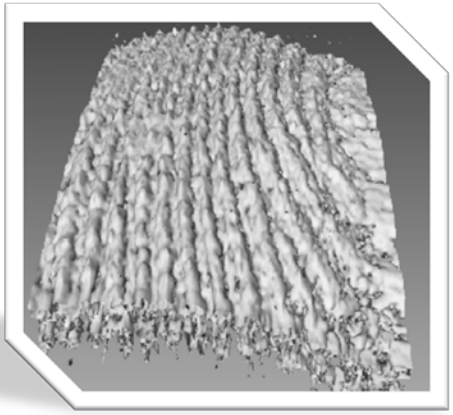
Agenda

- Introduction to National Instruments
- National Instruments Approach to Instrumentation
- National Instruments Technology for PDV
- Acknowledgements

The Impact of Great Engineering

Saving time, effort, and money

Improving quality of life



Averting catastrophic damage

NATIONAL INSTRUMENTS

Graphical System Design

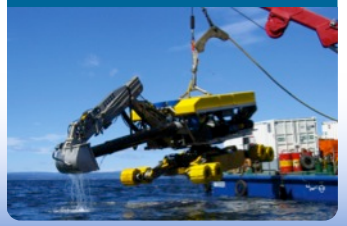
A Platform-Based Approach for Measurement and Control

Test

Monitor

Embedded

Control



Cyber Physical

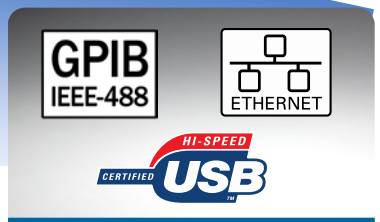
Graphical System Design

LabVIEW™

Desktops and PC-Based DAQ

PXI and Modular Instruments

RIO and Custom Designs



Open Connectivity with 3rd Party I/O

Integration of Modular I/O Hardware

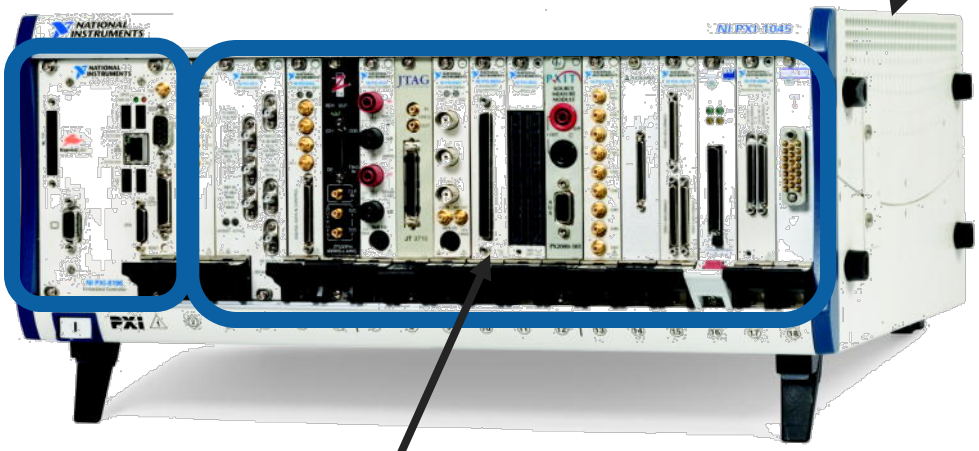
Box Instruments

Modular Instruments

PXI Combines Standard Technologies

Controller
- Embedded PC, remote PC/laptop interface, or rack mount
- Runs all standard software

Chassis—PXI Backplane
- PCI or PCI Express bus
- Timing and synchronization



Peripheral Modules
- More than 1,500 instruments from 70+ vendors

4 GB/s bandwidth per slot
12GB/s system bandwidth

PXI Express Slot 1

x16

x8

PCIe Switch

PCIe Switch

x8 x8 x8 x4 x8 x8 x8 x8 x8 x8 x8 x8 x8 x8 x8 x8 x8

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

PCIe to PCI

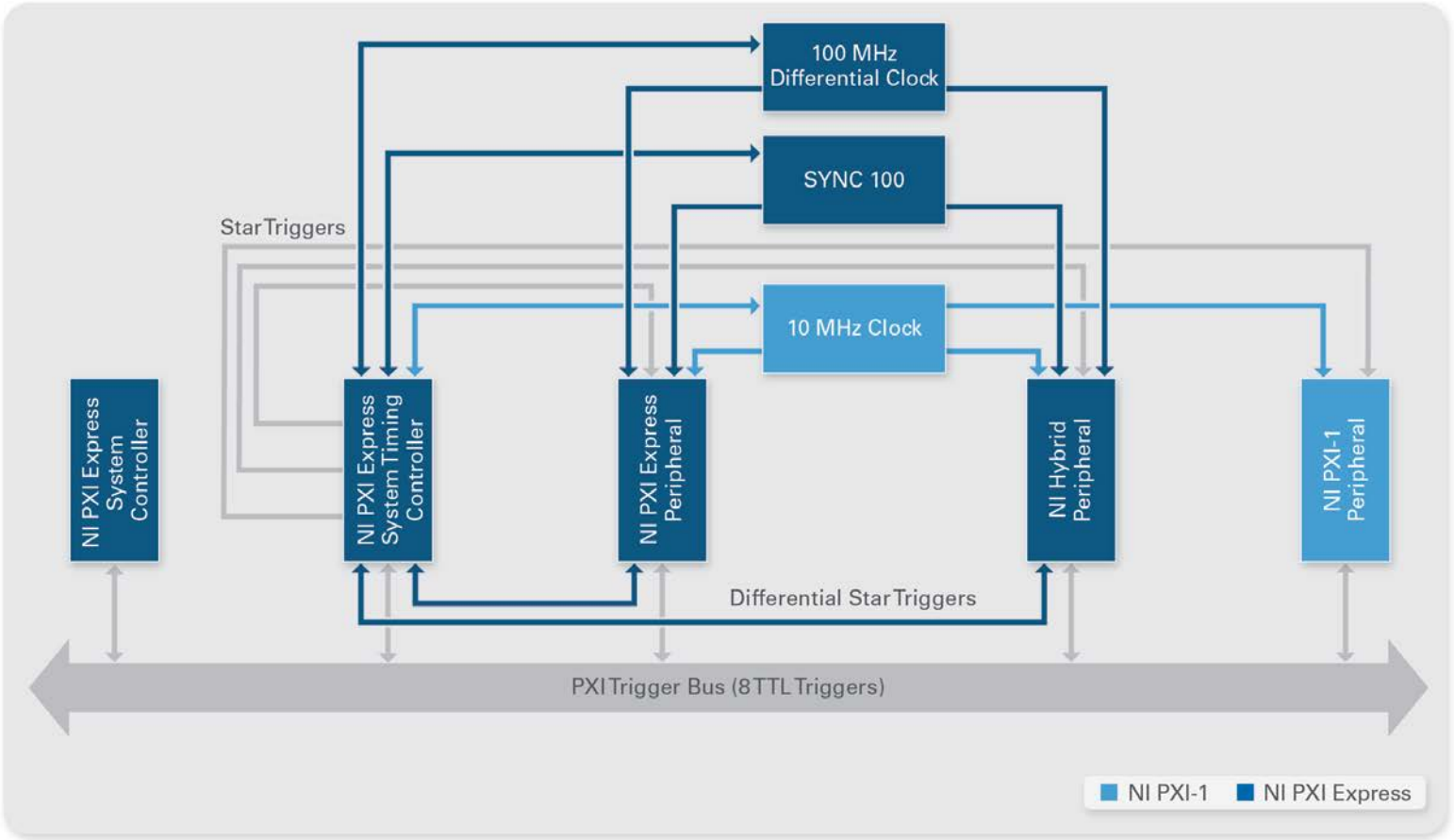
PCIe to PCI

Slot Color Legend

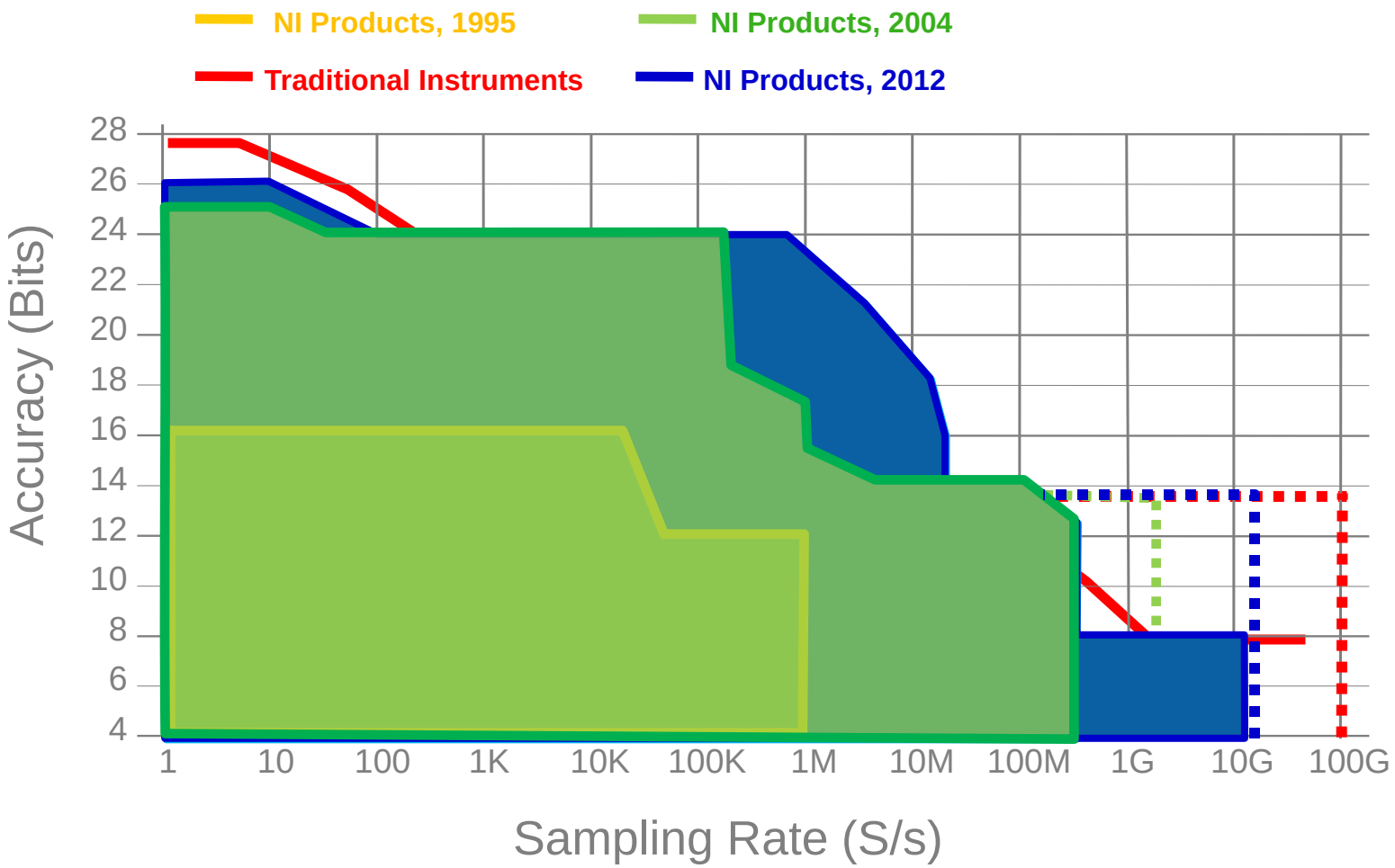
PXIe Hybrid

PXIe System Timing

PXI Timing and Synchronization Features



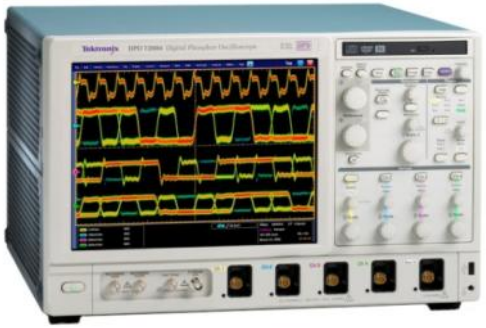
Expanding Measurement Capabilities



Highest Performance PXI Digitizer

Codeveloped by Tektronix and National Instruments

20 GHz, 50 GS/s Oscilloscope



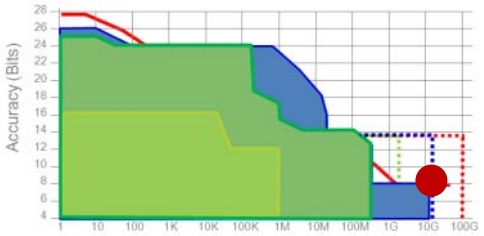
3+ GHz, 10+ GS/s Digitizer

Tektronix ADC ASIC

3U, 3-Slot PXI Express Digitizer

Tektronix® Enabling Technology

NI PXIe-5186 High-Speed Digitizer



	NI PXIe-5186	Digitizer A	Digitizer B
Analog Bandwidth	5 GHz	1.5 GHz	3 GHz
Sample Rate	12.5 GS/s	4 GS/s	8 GS/s
Vertical Resolution	8-bit ADC	10-bit ADC	10-bit ADC
Sampling Jitter	500 fs rms	1200 fs rms	1200 fs rms
RMS Noise	0.35% full scale	0.5% full scale	Not specified
ENOB	6 bits at 2.5 GHz	Not specified above 410 MHz	4.5 bits at 1.8 GHz
Form Factor	3U PXI Express	3U PXI	6U CompactPCI

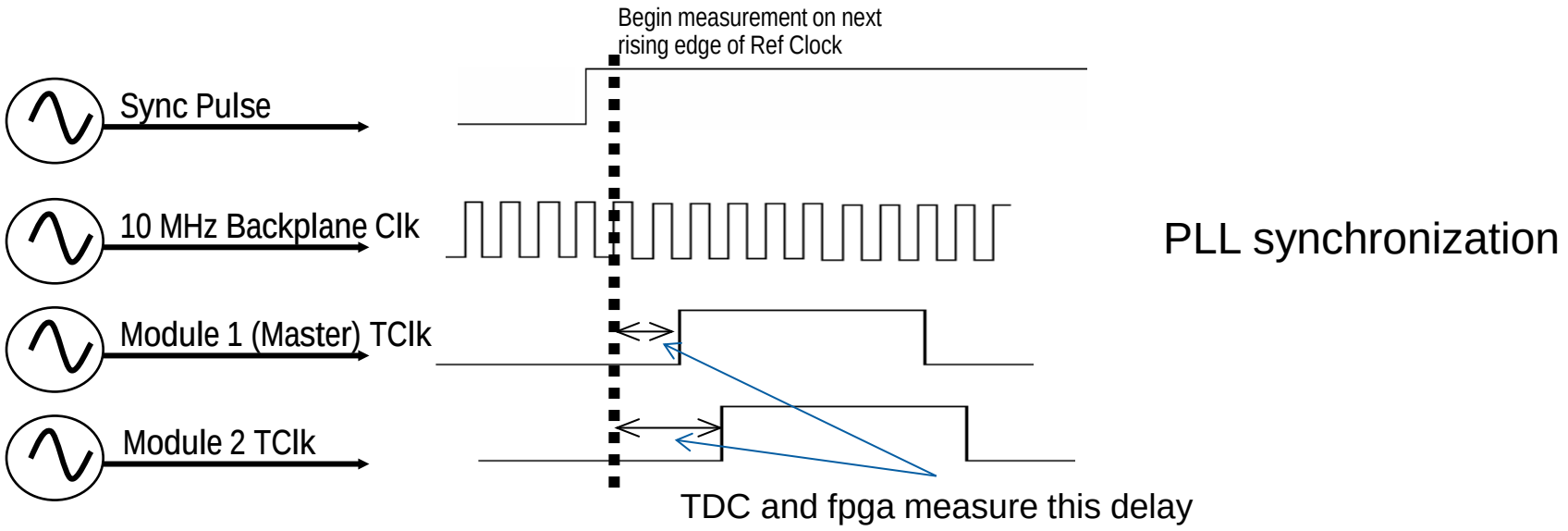
Tektronix Enabling Technology

NI PXI-5105
8-channel simultaneous
12-bit, 60 MS/s

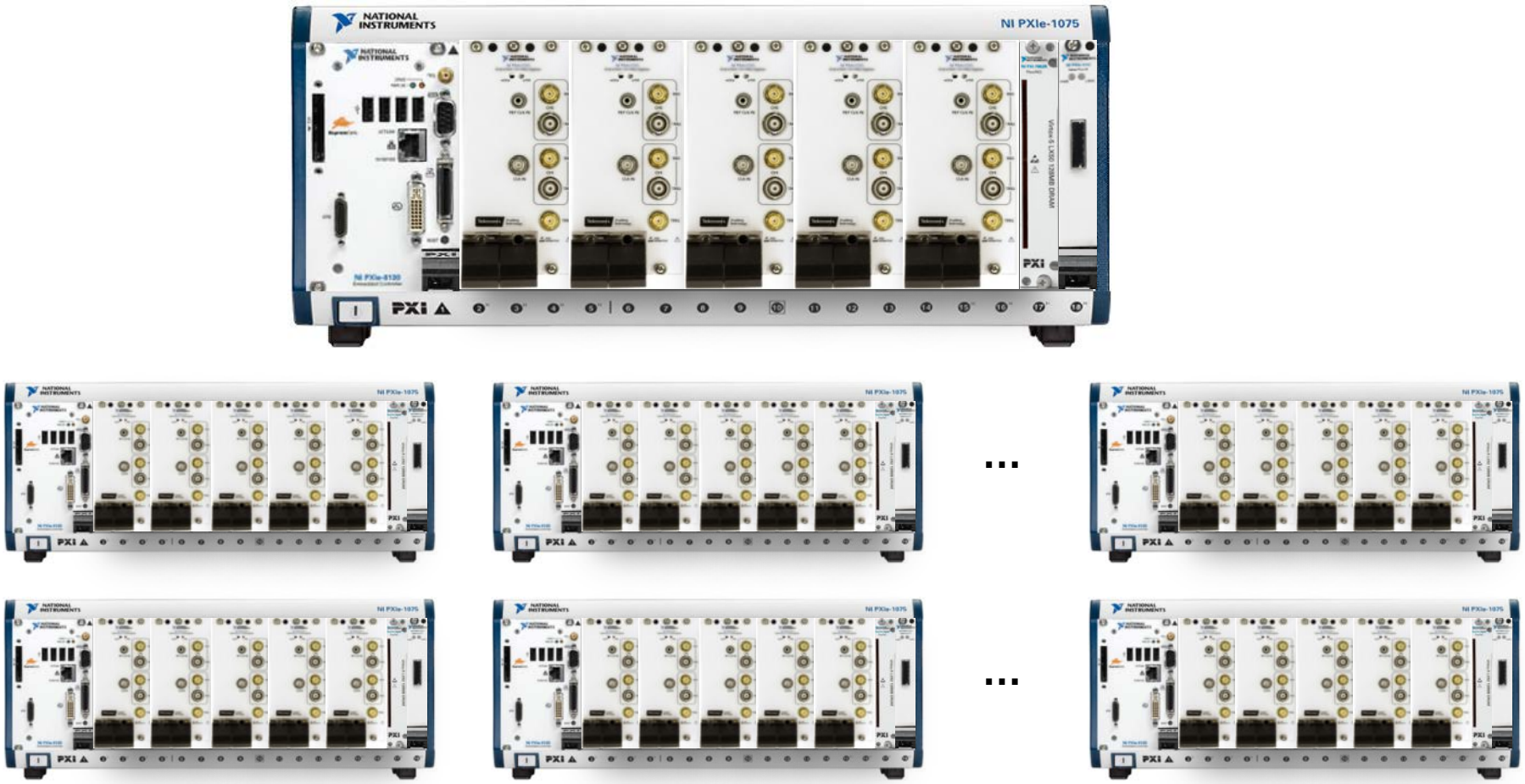
NI PXI-5922
Up to 24-bit and up to 15 MS/s
Up to -114 dBc SFDR

Trigger/Clock Synchronization -TClk

- Measure TClk edges from point of reference
  - 10 MHz backplane clock is our point of reference
  - Sync Pulse is sent to tell devices to begin measuring



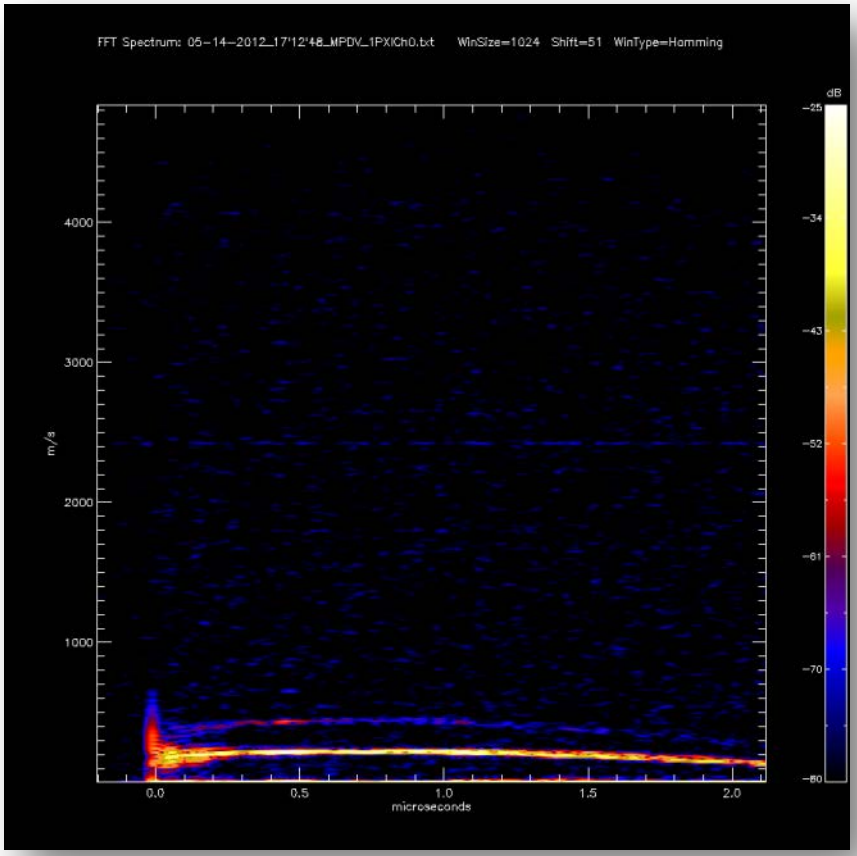
Modular PDV Acquisition System



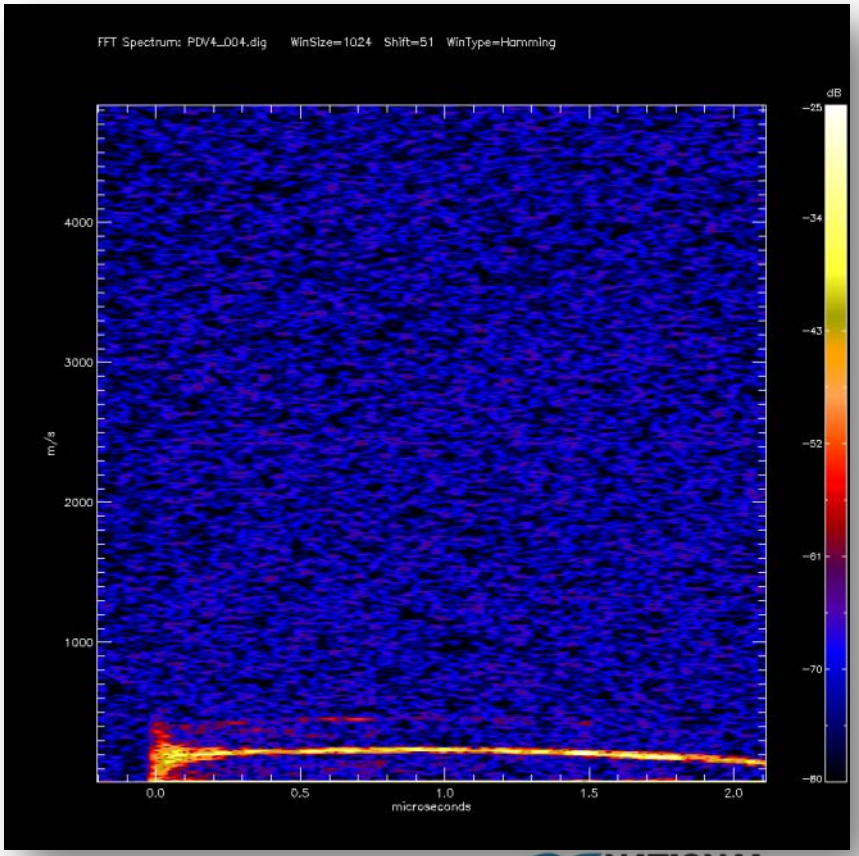
Multi-channel/chassis synchronization

PDV > 200 m/s Flyer Acquisition

- PXIe-5186
- 12.5 GS/s @ 5 GHz



- Tektronix DPO-72004
- 12.5 GS/s @ 20 GHz



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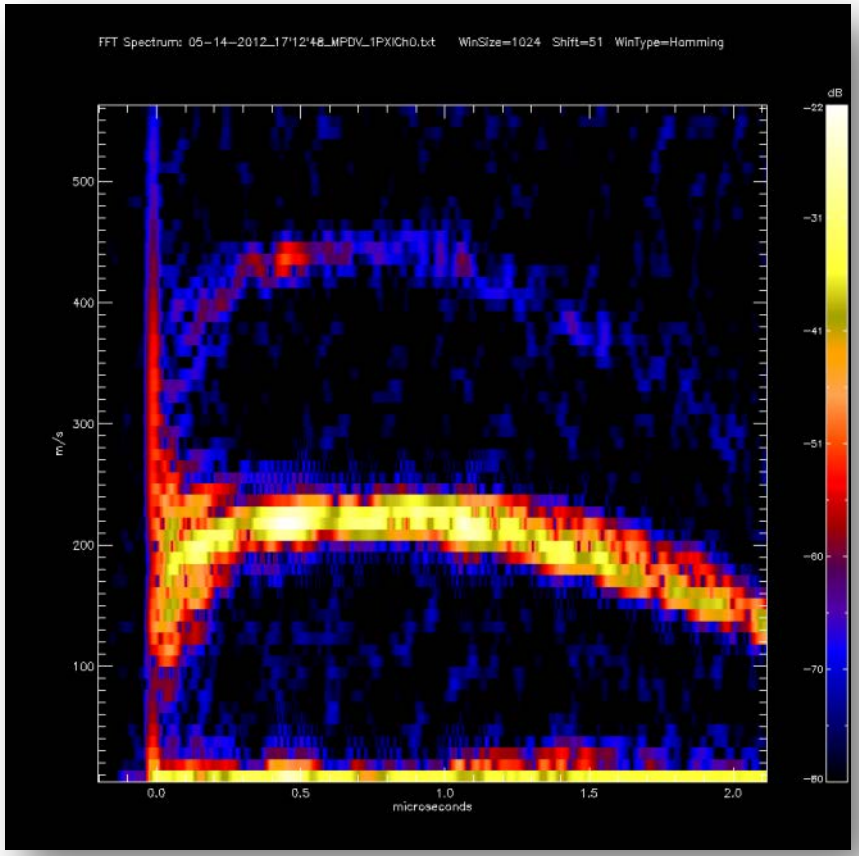

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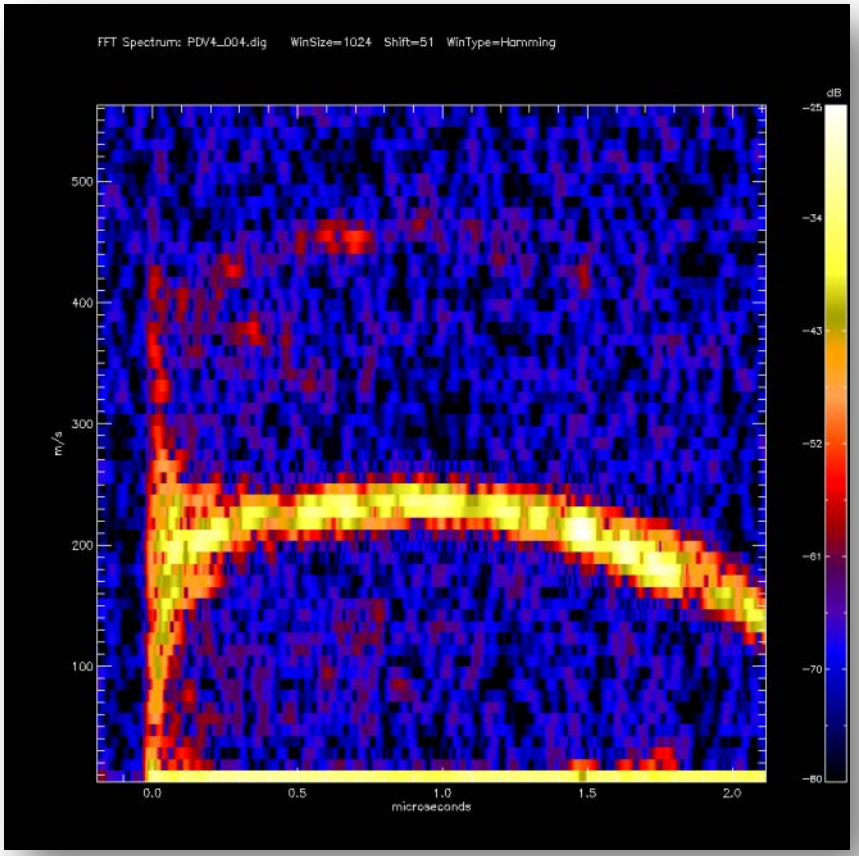
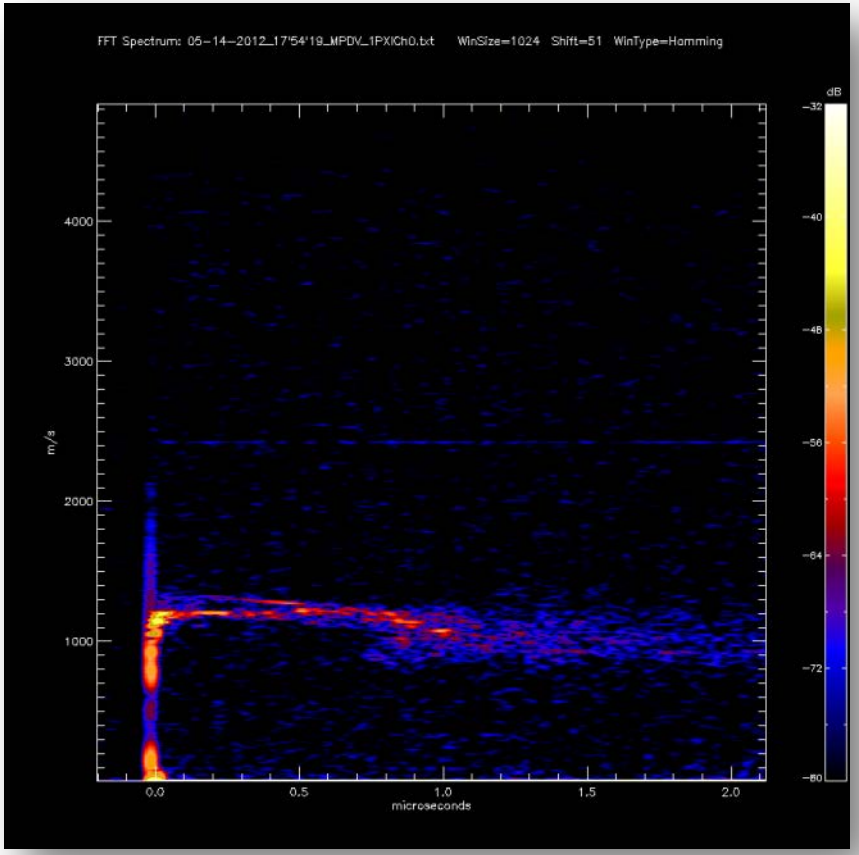


PDV > 1 km/s Flyer Acquisition

- PXIe-5186
- 12.5 GS/s @ 5 GHz



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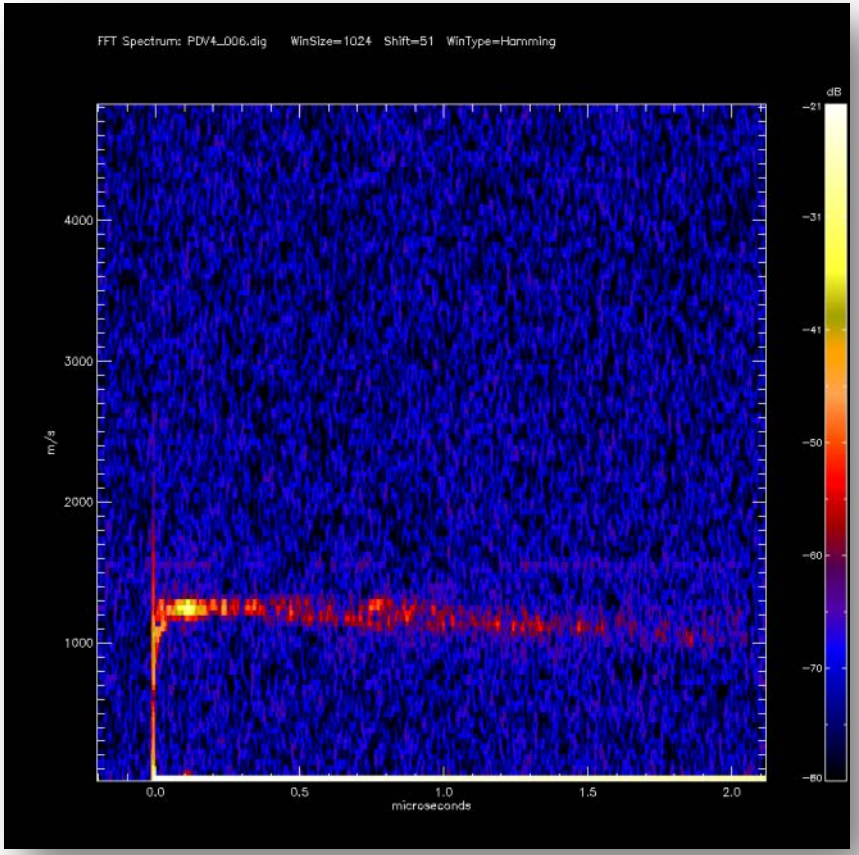

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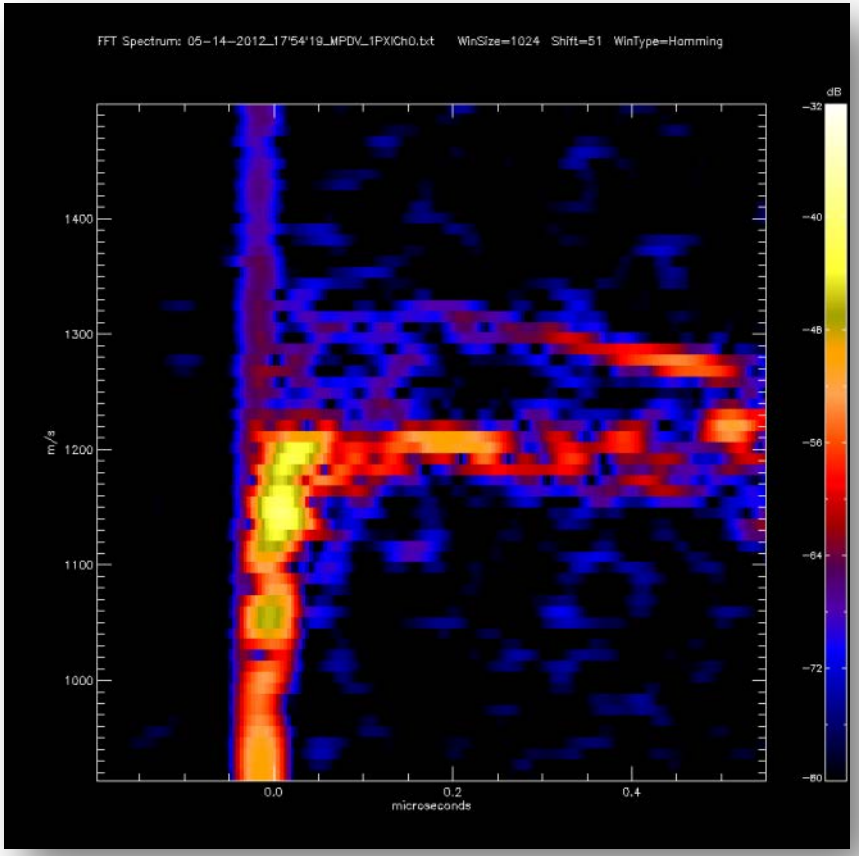

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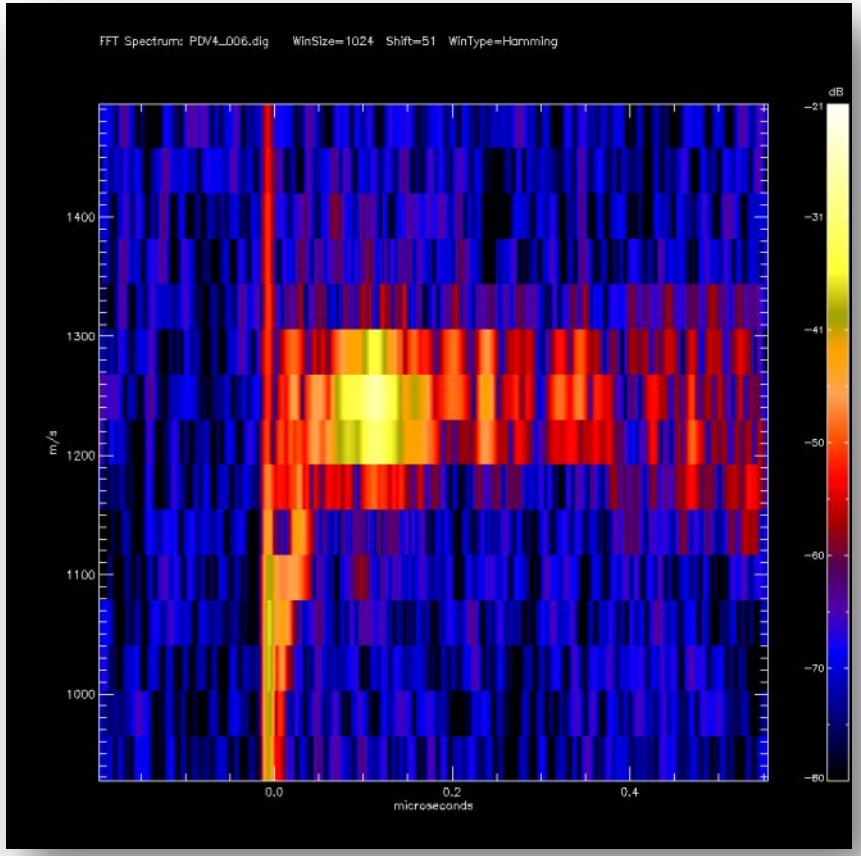
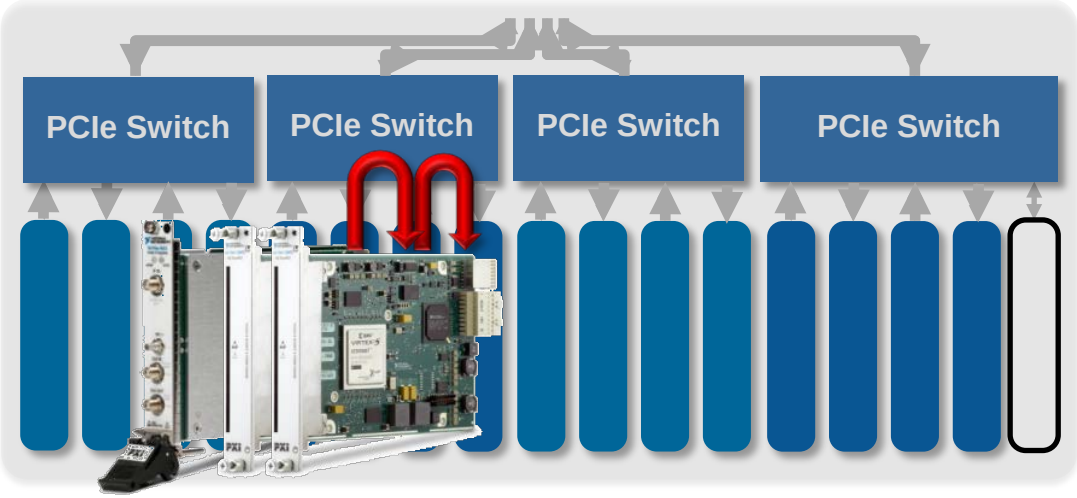


Synchronization: Digital Delay Generator

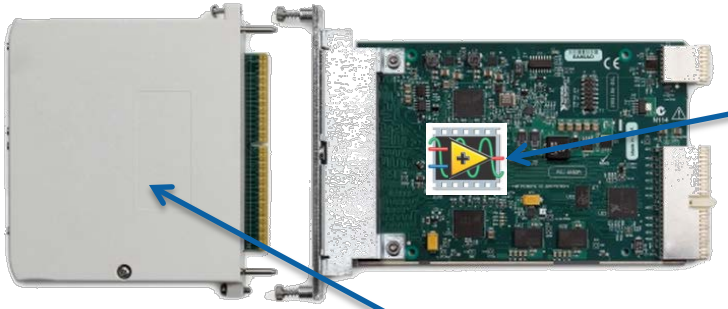
- Four high precision delays
  - Resolution: 1 ps
  - Jitter: < 50 ps rms
  - Selectable pulse amplitude and width
- Four auxiliary delays
  - Available on the front panel and on PXI Trig
  - Resolution: 5 ns
  - Jitter: < 100 ps rms
- Internal or external trigger (front & STAR)

P2P Architecture

- >800 MB/s one way
- >700 MB/s both ways
- ~10 µs latency
- Up to 16 streams per FPGA



FlexRIO



FPGA

Frontend
Adapter Module

Acknowledgments

- Cenobio Gallegos (NSTec – LAO)
- Matthew G. Teel (NSTec – LAO)
- David Esquibel (NSTec – LAO)